Dissecting adaptation capacity of Silver birch (*Betula pendula* Roth) to climate change

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Predicted climate change holds challenges for long lived forest trees. Genotypic plasticity is a key factor for species survival, and capacity to acclimate and adapt is becoming more important in a changing climate. Differences in growth (or accumulation of biomass) between individuals within a species over a number of years provide a clue as to how well individual genotypes are adapted to the current and future growing conditions or how well certain genotypes can tolerate adverse conditions. In our project we thus focus on within population variability of Silver birch (*Betula pendula* Roth).

For our study we exploit a birch experiment that was established in 1999 by randomly selecting 30 individuals for micropropagation from a naturally regenerated Silver birch stand in Punkaharju, Finland (61°48' N, 29°18' E). From the produced clones, 22 genotypes were planted in a common garden experiment. In 2008, after 9 years in the field, a thinning harvest was carried out by removing half of the trees. Biomass data of the 22 genotypes show great growth variation between the genotypes with about twice greater biomass in the fast-growing genotypes as compared to the slow-growing ones. We reason that after 9 years of field growth the observed large variation in above-ground biomass between the genotypes gives a strong signal of their adaptability. We propose that the fast-growing genotypes have superior capacity over the slow-growing ones to adapt to varying water regime and increasing temperature, and thus enable us to detect morphological, structural and functional mechanisms behind adaptability.

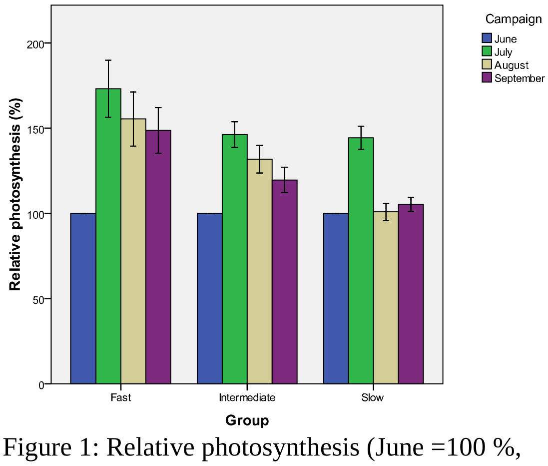

Figure 1: Relative photosynthesis (June =100 %, Mean ± SD) for Fast, Intermediate and Slow growing genotypes during four campaigns.

To start elucidating the reasons behind this obvious genotypic variation, we executed four measurement campaigns during the exceptionally dry and warm summer of 2010. Apart from growth and environmental parameters, we measured gas exchange parameters, fluorescence, water potential, leaf parameters (stomatal and trichome densities as well as leaf thickness), metabolites, chlorophyll content, volatile organic compounds emitted from the leaves as well as bud burst and leaf development in spring and senescence in the autumn.

Our results show that our fast-growing genotypes are able to maintain higher relative rates of photosynthesis during the growing season compared to our slow-growing genotypes, even under warm and dry conditions (Fig. 1). However, in June the measured net photosynthesis levels were lower in the fast-growing genotypes compared with the slow growing ones, indicating that photosynthesis levels alone cannot elucidate the variation in biomass accumulation between our genotypes. .This year's results suggest that fast growing genotypes are able to maintain steady photosynthetic activity longer, which might be the basis for higher biomass production. This hypothesis will be tested further in coming years in the field and by establishing controlled greenhouse experiments. Based on this first year's results, proper paremeters will be chosen to dissect adaptation capacity of Silver birch (Betula pendula) to climatic change.